AFML-TR-66-36

OPERATIONS OF A DOCUMENT RETRIEVAL SYSTEM USING A CONTROLLED VOCABULARY

E. A. JANNING

UNIVERSITY OF DAYTON RESEARCH INSTITUTE

TECHNICAL REPORT AFML-TR-66-36

MARCH 1966

Distribution of this document is unlimited.

AIR FORCE MATERIALS LABORATORY
RESEARCH AND TECHNOLOGY DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

NOTICES

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Copies of this report should not be returned to the Research and Technology Division unless return is required by security considerations, contractual obligations, or notice on a specific document.

700 - April 1966 - 773-39-845

OPERATIONS OF A DOCUMENT RETRIEVAL SYSTEM USING A CONTROLLED VOCABULARY

E. A. JANNING

FOREWORD

This report was prepared by the University of Dayton Research Institute under the Air Force Contract AF 33(615)-1132. The work described herein was accomplished under Project No. 7381 and Task No. 738103. The effort was administered under the direction of the Materials Information Branch, Materials Application Division, Air Force Materials Laboratory with H. B. Thompson, MAAM, as project monitor.

This is a summary technical report and covers the work accomplished from 1 December 1964 through 30 November 1965.

The author acknowledges the following named personnel who performed the input-output operations of the document retrieval system described herein and who provided the author with background information for his writing: Eugene R. Egan, M. Sue Kunihiro, Frederic L. Scheffler, Ralph B. Smith and James M. Tierney. The search strategies described in this report were developed by R. B. Smith.

Manuscript released by author January 1966 for publication as a RTD Technical Documentary Report.

This technical report has been reviewed and is approved.

D. A. Shinn
Chief, Materials Information Branch
Materials Application Division
Air Force Materials Laboratory

ABSTRACT

This report describes the effects that a controlled vocabulary has on the indexing and searching operations of the document retrieval system established by the University of Dayton for the Air Force Materials Laboratory. The system contains about 30,000 scientific and technical reports covering all aspects of materials research and is controlled by a vocabulary of 10,000 terms. In general, the use of a controlled vocabulary has been found to be very beneficial to the overall operation of the system. Also described are three search strategies that are used to effectively retrieve information in a format that is more useful to a user than merely a list of document numbers.

TABLE OF CONTENTS

I. INTRODUCTION

The Air Force Materials Laboratory (AFML), through its Materials Information Branch, sponsors, supports or controls the activities of seven specialized information and data centers which are located throughout the country. These activities are collectively referred to as the Air Force Materials Information Centers (AFMIC) and have the common goal of satisfying materials information needs of the scientific and technical community. The Aerospace Materials Information Center (AMIC) is an organization within the Air Force Materials Laboratory that collects, interprets, organizes and disseminates technical information on all materials of concern to the laboratory in conjunction and coordination with the other Air Force Materials Information Centers. The University of Dayton, under contract to the Air Force, established and has maintained a document retrieval system for a collection of approximately 30,000 scientific and technical reports to service the partial needs of that center. The establishment and modification of the system are described in detail in the previous reports RTD-TDR-63-4263 (AD 428423) and AFML-TR-65-20 (AD 613301).

This report describes work accomplished from December 1964 to December 1965 and is primarily concerned with a review of operating the system with modifications made the previous year. To better understand this review, the aforementioned reports are summarized below.

The original system that was established by the University was a coordinate indexing system based on the use of very specific terminology and the utilization of links and roles. The information to be contained in the system was a collection of approximately 10,000 scientific and technical reports that dealt with all aspects of materials research of interest to the Air Force. There was no predetermined vocabulary and the indexers were permitted to use whatever terminology that was needed to adequately describe the documents they indexed. The first five hundred documents that were indexed averaged over eighty link-role-term combinations per report. As the indexers gained experience, the average number of entries was gradually reduced to slightly over forty.

An attempt to build a thesaurus of the system's vocabulary was made during the second year of operation. At that time, about 6,000 documents had been indexed and a thesaurus of slightly over 18,000 terms was generated. When the system was updated in December 1963, the addition of 4,000 documents to the system generated 30,000 new terms. Although the system had been used to effectively retrieve information in answer to search queries, the rapid growth of the vocabulary became of concern since it was desirable to maintain manual searching capabilities.

The results of an evaluation of the use of links and roles in the system, and the rapid growth of the vocabulary, formulated the basis for modifying the system during the fourth year of operation. Although the use and value of role indicators were questioned during the period of establishing the system, a decision was made to continue their use until the system was operable and could be formally evaluated. An evaluation was made after the system was established and confirmed the opinion that the use of roles was more detrimental than helpful to the system. The use of roles was then discontinued and that elimination, in addition to the continual growth of the vocabulary, necessitated modifications in, and the establishment of, vocabulary controls.

The naming of materials, primarily metallic alloys and organic compounds, accounted for the major portion of the rapid and apparently unending growth in the vocabulary. Since the documents that were indexed into the system dealt with the research and development of materials, the generation of new terms was anticipated but the quantity far exceeded the expectations. The approach taken to establish a vocabulary control was to divide the vocabulary into classes of materials for analyses. The purpose of each analysis was to determine the possibility of generalizing the naming of materials without losing an undue amount of specificity. Through these generalizations, controls were established for the naming of materials and the system's vocabulary was reduced to approximately 10,000 terms. Although 6,000 new documents have been added to the system during the past year, the vocabulary has remained fairly constant.

The remainder of this report deals with the effects of the vocabulary controls on the input-output operations of the system. A listing of the searches performed by the University during the past year is appended to this report.

II. INPUT OPERATIONS

The elimination of role indicators in the indexing process had the immediate effect of reducing the average number of index entries per report from slightly over 40 to about 27. Since the evaluation of the use of roles showed that they harmed rather than helped the system, both the efficiency and effectiveness of the system were improved through their elimination. The use of a controlled vocabulary during the past year, particularly in the naming of materials, has further reduced the average number of index entries per document to 12 or 13. Several of the first documents indexed at the University were reindexed to see the effect that the vocabulary controls and the elimination of role indicators had on indexing. Even though several of those documents had originally been indexed with more than 200 entries each, they were reindexed with less than 20 entries per document. In all cases, about half of the reduction was caused by eliminating the role indicators

while the remainder of the reduction was brought about by the use of generic groups in the naming of materials and the reduction in the use of links.

Under the system of controlled vocabulary, indexing speed has been greatly facilitated. It is much easier for the indexer to become familiar with the terminology in a system where the vocabulary remains more or less static. It should be noted here that the University is not operating with a closed vocabulary. It is still possible, and very desirable, to add, change or delete terms as needed. The primary effect of the vocabulary changes made was to provide a more generalization of terminology while still maintaining a fair degree of specificity. This generalization has tended to require the indexer to use more discretion in the choice of index terms and to disregard the minor details of each report indexed. Since the size of this system has grown from 6,000 to 30,000 documents, the minor details of each report are no longer required to answer questions. They would, in fact, be overlooked when retrieved with more pertinent documents since abstracts of retrieved documents are the primary means of screening search results and abstracts generally cover only the more important parts of the reports.

It is difficult to give a quantitative evaluation of the merits of the controlled vocabulary at this time since any evaluation would be highly subjective. All of the University staff members who are indexing documents at the present time were also the persons who established the vocabulary controls and are the individuals who set up and screen search queries. This situation is, of course, ideal and provides for a very workable system. Each individual maintains control over the vocabulary in his field of interest and any changes that are needed are somewhat dictated by the vocabulary needed to index the documents in his area and the type of terms needed to formulate search questions.

The present vocabulary now contains terms that are capable of accommodating nearly all indexing situations. Because of the work that has been invested in deriving this useful vocabulary, it is respected by the indexers and a genuine effort is made to logically express indexable material with existing terminology. New terms are added only after careful thought by the staff and only when they are needed and cannot conveniently be accommodated with the existing vocabulary. Instead of creating new terms for infrequent occurrences, scope notes are used to provide additional or more specific information for the screening of search results. The scope notes may appear either on the indexing record or in a 3"x5" card file that each indexer maintains of terms that do not appear in the vocabulary. Each card contains enough information to define the new term and to indicate the term or combination of terms used to express the new term in the existing vocabulary. As the frequency of use of a new term increases, it is reviewed for possible inclusion in the system. This procedure prevents the use of unnecessary terms.

information on some general properties of a specific material is often requested. Even though specific materials are scope noted on the index records, the number of records to be screened is often quite large. The handling of metallurgical terminology will require further analysis and modification.

The fact that the majority of questions asked of this system have dealt with properties of materials led to the development of three search strategies. Depending on the information sought, any one of these strategies can effectively be used to set up the search questions, screen the search results, and provide the user with a categorized listing of the properties and/or materials. Although terms have been coined to differentiate the strategies, they will be referred to as strategies 1, 2 and 3 in this report. Although the various strategies can be generalized, a clear description of them cannot be given without the use of examples. The cited examples can be interpolated to meet the requirements of similar problem situations.

Search strategy 1 was used to answer an information request on fabrication techniques for high temperature resin sandwich structures with emphasis being placed on the use of PBI or polyimide resins and adhesives. The search strategy used involved the grouping of six Boolean expressions:

Group 1	AND	Fabrication
	OR	Manufacturing Technology
Group 2	AND	Sandwich Structure
	OR	Polyimides
	OR	Nitrogen Heterocycle Polymers
	OR	Heat Resistant Polymers
	OR	Adhesives
Group 3	AND	Sandwich Structure
	OR	Polyimides
	OR	Nitrogen Heterocycle Polymers
	OR	Heat Resistant Polymers
Group 4	AND	Sandwich Structure
	OR	Polyimides
	OR	Nitrogen Heterocycle Polymers
Group 5	AND	Sandwich Structure
	OR	Polimides
Group 6	AND	Sandwich Structure

No attempt will be made here to explain the choice of terms used in the search since it is the grouping of the terms that is important to the strategy used. The cutoff point for this search was chosen at the end of the second group. This meant that at least one term from the first group and one term from the second group must have appeared in the indexing of a document to be accepted as a document that satisfied the requirements of the search. The computer program used by the University prints out search results in reverse order; that is, it first prints out the numbers of documents that contain

all the words in the search (since they should be the ones most pertinent to the question) and gradually decreases one group at a time until the cutoff point is reached. In analyzing the results of the above search, any document listed as containing terms from all six groups meant that at least one of the terms in the first group and the term SANDWICH STRUCTURE were used in the indexing of that document. This is true because in the search strategy the term SANDWICH STRUCTURE was repeated each time from the second through the sixth group. The second listing on the search tabulation showed the documents that contained one of the terms from the first group and at least the term POLYIMIDES but not SANDWICH STRUCTURE. This can be analyzed from the fact that if SANDWICH STRUCTURE appeared in the indexing of a document, that document would have been carried through all six groups. This same elimination process holds true right on down to the cutoff point. Any documents listed in this last group meant that either of the terms FABRICATION or MANUFACTURING TECHNOLOGY and the term ADHESIVES were used in the indexing of those documents but not the terms SANDWICH STRUCTURE, POLYIMIDES, NITROGEN HETEROCYCLE POLYMERS or HEAT RESISTANT POLYMERS. If any of those latter terms had been used in conjunction with one of the terms from the first group, the document would have appeared earlier in the tabulation of the search results. By using this strategy the searcher was able to furnish the user with a listing of documents that pertained to the fabrication or manufacturing technology of sandwich structures, the fabrication or manufacturing technology of polimides often used in sandwich structure, the fabrication or manufacturing technology of nitrogen heterocycle polymers, the fabrication or manufacturing technology of heat resistant polymers, and finally the fabrication or manufacturing technology of adhesives.

Search strategy 2 gives the same results as strategy 1 but can often be used to effectively shorten the search query. However, since this strategy involves use of the Boolean expression "NOT", extreme care must be taken so as not to eliminate pertinent information. The example used to explain this strategy is based on a request for information on ceramic reinforced composites. The search was set up as follows:

Group 1	AND	Reinforcement
	OR	Whiskers
	OR	Filaments
	OR	Fibers
Group 2	NOT	Polymers
Group 3	AND	Composites
Group 4	NOT	Glasses
Group 5	NOT	Nitrides
Group 6	NOT	Carbides
Group 7	NOT	Graphites
Group 8	NOT	Borides
Group 9	NOT	Single Oxides

Group 10	NOT	Boron
Group 11	NOT	Mixed Oxides

Again, the choice of terminology is not important to understanding the strategy used. Since composites was the important concept of this request, the cutoff was placed after group 3 and, as in strategy 1, the results are tabulated in reverse order. Therefore the first list of documents would contain the term COMPOSITE, one of the terms from the first group, but none of the terms from group 2 or from groups 4 through 11. The second listing of documents would be concerned with mixed oxide reinforced composites, the third grouping with boron reinforced composites, etc. This strategy is not without its faults since the listing containing, for instance, all boron reinforced composites is not necessarily complete. If a document had been indexed with the terms GLASSES and BORON along with some type of reinforced composite, the term GLASSES would prevent it from being listed with other documents pertaining to boron reinforced composites. This strategy does, however, break the retrieval into categories that may be of value to the user. This is particularly true if some type of weighted value can be assigned to the "NOT" groups with the more weighted value being listed first and the remainder in descending value of importance.

Strategy 3 involves the running of multiple searches to answer a single question. This strategy is most helpful when searching for various properties of several materials. The example used in this case is based on a request for information on the thermodynamic or physical properties of aluminum, copper, tin and iron halides. The requestor also wanted information on the synthesis, kinetics and decomposition of the metal halides as well as information on any other properties of the halides that may be in the system. In setting up the search strategy for this question (which will not be repeated here because of its length), the halides reported in the system at that time were aluminum chloride, aluminum bromide, aluminum iodide, aluminum fluoride, copper chloride, copper bromide, copper iodide, iron chloride, iron bromide, iron fluoride and tin chloride. The properties and other terms used to correlate with the halides were physical properties, thermodynamic properties, thermodynamics, synthesis, decomposition, dissociation, kinetics, chemical reduction, oxidation, vaporization and sublimation. By use of strategy 1, the searcher was able to correlate the individual halides with the general group of properties and separate out each metal halide. Thus, in the search result tabulation, there were 13 documents listed as containing the term iron chloride and at least one of the terms from the list of properties. By reversing the two major groups of terms in a second question, the searcher was able to correlate the individual properties with the general group of halides so that in the search tabulation it was shown, for example, that 18 documents were concerned with the physical properties of one or more halides. By manually correlating the two results, the searcher was able to tell the user which documents dealt with the physical properties of aluminum chloride, which documents dealt with the thermodynamic properties

of iron chloride, etc. Although either one of the searches would have answered the question, by combining the two searches it is believed that the user was furnished with more useful information that undoubtedly saved him valuable time.

The strategies discussed above were based on the assumed capabilities of the University's computer facilities. The system's complete data bank, along with the established programs, was transferred to the WPAFB computer facilities at the end of this reporting period. It is hoped that further advancement in search strategies will be possible on this larger computer. In particular, all strategies now used are limited by the term-group order. That is, at least one term in the first group must be present before a search is made for a term in this second group, a term from each of the first two groups must be present before a search is made for a term in the third group, etc. It is conceivable that in a search containing eight term-groups, many documents may not have been retrieved due to a missing term from one of the first groups. It is desirable, therefore, to have a search program that is not restricted to term-group order but that will tabulate the documents according to the number of term-group correlations such as any six out of eight, five out of eight, etc., and to list the groups or terms that caused the correlation. A program of this kind is now under study.

IV. SUMMARY

The use of a controlled vocabulary has greatly increased the efficiency of the document retrieval system that was established by the University for the Air Force Materials Laboratory. The system now contains about 30,000 scientific and technical documents pertaining to all phases of materials research and is controlled by a fairly stable vocabulary of 10,000 terms. The only area in which any difficulty has arisen is in the searching for specific materials in the field of metallurgy; the number of requests for specific materials is increasing and more time is required to screen search results. In all other areas, the controlled vocabulary has been beneficial to both the indexing and the searching processes as well as reducing the size of the data bank.

The overall system will be complemented during the coming year by the use of microfilm equipment. When this system was first established, a decision was made not to include symposia proceedings or handbooks in the system until a later date. As the size of the system increased, it became less desirable to include those items in the main system. A method of handling symposia proceedings and handbooks is now available, however, through the Laboratory's purchase of a Recordak Miracode System. In addition, that system will also be able to handle abstracts of reports that are received from Foreign Technology Division and any other subsystems

that may eventually be established. Microfilm equipment will also be used at the University for the indexing of documents that are received only in micro card form, for screening search results, and for furnishing users with abstracts of pertinent documents instead of merely access numbers. Since the Laboratory is not a document distribution center, the bibliographic information that is contained on the abstract sheets will be helpful in ordering copies of the documents from the Defense Document Center or other distribution points.

APPENDIX I

SEARCH QUESTIONS PROCESSED
December 1964 - December 1965

COMPUTER SEARCHES

Search No.	Requestor	Topic of Search
141	WPAFB	Magnesium inert gas welding of steels
142	WPAFB	Joining of titanium
143	WPAFB	Brazing of aluminum
144	WPAFB	Plasma arc welding
145	WPAFB	Cutting tools - service life
146	WPAFB	Joining of wire fabrics
147	WPAFB	Beryllium corrosion
148	WPAFB	Beryllium welding
149	WPAFB	Coatings for refractory metals
150	WPAFB	Titanium alloy rolling
151	WPAFB	Titanium casting and forging
152	WPAFB	Extrusion lubrication
153	WPAFB	Diffusion bonding
154	WPAFB	Refractory metal nozzles
155	WPAFB	Coatings for nickel alloys
156	WPAFB	Superalloy castings
157	WPAFB	Manufacturing process for corrosion resistant steels
159	WPAFB	Formable refractory metals
160	WPAFB	High energy rate forming
161	WPAFB	Propellant compatible adhesive
162	WPAFB	Fuel compatible adhesives
163	WPAFB	Welding of high temperature alloys
164	WPAFB	Grinding of thermal resistant material
165	WPAFB	Refractory metals in hydrogen
166	WPAFB	Roughness measurement methods
168	WPAFB	Electron mobility in alkanes
169	WPAFB	Excitation parameters
170	WPAFB	Accommodation coefficient
171	WPAFB	Aluminum oxide- rare earth oxides
172	WPAFB	Electrophoreisis
173	WPAFB	Index of refraction of glasses
174	WPAFB	Low temperature theory
175	WPAFB	Calcuim & Lanthanum spectra
176	WPAFB	Calcium & Lanthanum doped spectra

Search No.	Requestor	Topic of Search
177	WPAFB	Light metal hydride propellants
178	WPAFB	Boron nitride windows
179	WPAFB	Welding comparison
180	Tech. Voc. High School	Rockets or space stations
181	WPAFB	Thermodynamic properties of alloys
182	WPAFB	Optical properties of alloys
183	WPAFB	Thermodynamic properties of ceramics
184	WPAFB	Optical properties of ceramics
186	WPAFB	Inorganic composites
187	WPAFB	Transducer theory
188	WPAFB	Oxidation of copper and iron
189	WPAFB	Thermodynamic properties of metals
190	WPAFB	Optical properties of metals
191	WPAFB	Thermodynamic properties of polymers
192	WPAFB	Optical properties of polymers
193	WPAFB	Welding comparison
194	Univ. of Dayton	Evaluation of materials for composite materials
195	WPAFB	Heat resistant polymers
196	Univ. of Dayton	Testing retrieval of organic compounds
198	WPAFB	Dimensional instability
199	WPAFB	Glass filaments
200	Univ. of Dayton	Superalloy development-processes
201	Univ. of Dayton	Superalloy development-materials
202	Northrop Norair	Ti-Al-Mo-V Hot forming tooling
203	WPAFB	Vinyl polymer coatings
204	Univ. of Dayton	Polymer checking
205	WPAFB	Polymers as dielectrics
206	WPAFB	Physical properties of ceramics
208	WPAFB	Physical properties of mixed oxides
210	Univ. of Dayton	Polymers and welding fillers
213	Univ. of Dayton	Superalloy development
214	WPAFB	High strength aluminum alloys
216	WPAFB	Electrets
219	WPAFB	Properties of mixed oxides
221	Univ. of Dayton	Fatigue of fibers
222	WPAFB	High temperature thermal insulation
223	WPAFB	Properties of welds
224	WPAFB	Properties of infiltrated tungsten
225	WPAFB	Superalloy extrusion
226	WPAFB	Nickel coating emittance
227	WPAFB	Refractory metals strengthening

Search No.	Requestor	Topic of Search
228	WPAFB	Properties of aluminum bronze
229	Monsanto	Metal chelates
233	WPAFB	Glass filaments
234	Monsanto	Acid halides
238	WPAFB	Toughness of aluminum alloys
239	WPAFB	Fuel element temperature measurement
240	WPAFB	Analysis of tungsten disilicide
242	WPAFB	Anelasticity
243	Monsanto	Metal chelates
244	WPAFB	Cutting pure beryllium
247	WPAFB	Glass fibers
248	WPAFB	Properties of methane
249	WPAFB	Hydrogen permeability
250	WPAFB	High temperature wire insulation
252	WPAFB	Thermoelasticity
253	WPAFB	Ceramic thin films
254	WPAFB	Single crystal thin films
256	WPAFB	Refractory alloys
257	Monsanto	Properties of metal halides
260	WPAFB	Nuclear magnetic resonance spectrometry
265	WPAFB	Residual stress measurement
266	WPAFB	Ni & Co powder superalloys
267	WPAFB	Corrosion control for steel
268	WPAFB	Resistance to particle impact
269	Univ. of Dayton	Testing retrieval of organic compounds
271	Univ. of Dayton	Gettering, dispersal
274	WPAFB	Deposition of ceramic oxides
275	WPAFB	Spectral emittance of ceramics
276	WPAFB	Deformation hardening
277	WPAFB	Particle impact
278	WPAFB	Guidance system stability
279	WPAFB	Superalloys
281	Univ. of Dayton	Iron base superalloys check
282	WPAFB	Superalloy toughness
283	WPAFB	Cold welding aluminum alloys
285	WPAFB	Aircraft structural fatigue
287	Univ. of Dayton	Properties of metals
289	WPAFB	Weathering of reinforced plastics
290	WPAFB	Reinforced plastics as primer structures
291	WPAFB	Diffusion bonding
293	WPAFB	Electrical properties of metallic oxides
295	WPAFB	Plastic primer structures
296	WPAFB	Properties of foams

Search No.	Requestor	Topic of Search
297	WPAFB	Nondestructive testing
298	WPAFB	Applications of ceramics
299	WPAFB	Metal foams
300	WPAFB	Aerospace insulation
302	WPAFB	Reactions of noble gases
303	Univ. of Dayton	Strengthening of metals
304	Univ. of Dayton	Silicon carbide semiconductors
305	WPAFB	Strain gauges
306	WPAFB	Infrared lasers 2-100 microns
307	Northrop Norair	Diffusion of tantalum alloys
308	USAECOM	Oxidation & Reduction of ceramics
312	McClelland AFB	Transverse tensile aluminum 7075-T6
313	Douglas Aircraft	Forming apparatus-hydroclaves
315	WPAFB	High strength fibrous composites
317	Hamilton-Standard	Stress corrosion 17-4 PH
318	WPAFB	17-4 PH forgings
319	WPAFB	Permeation of hydrogen in stainless steel
320	WPAFB	Properties of glasses
321	WPAFB	Absorbtion of hydrogen in stainless steel
322	WPAFB	Hydrogen thermal conductivity
323	Univ. of Dayton	Superalloys
325	WPAFB	Hydrogen in stainless steel
326	U. S. S.	Reduction effect on steels
328	WPAFB	Titanium alloy fatigue
330	WPAFB	Tubing stress-rupture
331	WPAFB	Liquid metals compatibility
332	WPAFB	Numerically controlled forming
335	WPAFB	Growing of single crystals
343	WPAFB	Isotropic sheet and plate materials
344	WPAFB	Superalloy powders
345	WPAFB	Beryllium sheet manufacture
346	WPAFB	Rolling superalloys
351	WPAFB	Deep drawing
359	WPAFB	Explosive spot pining
360	WPAFB	Flame spraying ceramics
361	WPAFB	Transparent materials
362	USAECOM	Fluidized bed reactions
363	WPAFB	Thermal stress analysis of ceramic cylinders
364	WPAFB	Ablation of re-entry vehicles and rocket nozzles
380	Univ. of Dayton	Superalloys

Search No.	Requestor	Topic of Search
382	WPAFB	Silicon carbide fibers in metal matrices
383	Univ. of Dayton	Adsorption of inorganic materials
386	WPAFB	Mechanical properties of laminates
387	WPAFB	Permeability and compatibility of elastomers and plastics
388	WPAFB	Degree of purity of HCl
389	WPAFB	Packaging methods for integrated circuits
390	WPAFB	Weldable multilayer circuit boards
391	WPAFB	Manufacturing processes for integrated circuits
392	WPAFB	Cross field amplifiers
393	WPAFB	Deposition of semiconductor films
395	WPAFB	Semiconductor & thin film circuitry
396	WPAFB	Growing epitaxial material for semiconductors
397	WPAFB	Manufacture of electron tubes
398	WPAFB	Manufacture of memory systems
399	WPAFB	Electric motor materials
403	WPAFB	Ceramic machining
404	WPAFB	Ceramic thin films
406	WPAFB	Gas turbine engine materials
407	WPAFB	PBI & polyimide composites
408	WPAFB	Filament winding glass fiber fuel hoses
410	WPAFB	Chemical bonded film on aluminum
411	WPAFB	Temperature control of reflective coatings
412	WPAFB	Protective coatings for metals
413	WPAFB	Electrostatic coatings of tanks
414	WPAFB	Machining composites
415	WPAFB	Weaving three-dimensional fabrics
416	WPAFB	Manufacturing $GaAs_xP_{1-x}$ semiconductors
417	WPAFB	Waveguide folding machine
418	WPAFB	Shims for airfoils
419	WPAFB	Long term aging of elastomers
420	WPAFB	Attaching or joining composites
421	WPAFB	Charring ablative materials
422	WPAFB	Measurement of thermal conductivity of pyrolytic carbon
423	WPAFB	Structural defects - effect on composites
424	WPAFB	Filament wound glass bottles
426	WPAFB	Vapor deposition of metals

Search No.	Requestor	Topic of Search
427	WPAFB	Ballistic impact on metals
428	WPAFB	Strength effect of rare earth elements
429	WPAFB	Rare earth metals and oxidation of alloys
430	WPAFB	Liquid metal corrosion
431	WPAFB	Protective coatings for Ni, Co alloys
432	WPAFB	Oxidation of Ni, Co alloys
433	WPAFB	Mechanical properties and oxidation of metal composites
434	WPAFB	Tensile properties of whiskers
435	WPAFB	Fatigue of steel 4340
436	Univ. of Dayton	High viscosity & density of polymeric liquids
438	WPAFB	Single crystals of refractory oxides
439	WPAFB	Dielectric host crystals
440	WPAFB	Preparation of pervoskites
441	WPAFB	Spectroscopy
441	WPAFB	High temperature structural material properties
442	WPAFB	Absorptance of opaque materials
443	WPAFB	Reflectance measurement
444	WPAFB	Fibrous thermal insulation
445	WPAFB	Specific heat of foams
446	WPAFB	Formulation of plastic composites
447	WPAFB	Addition of fillers
448	WPAFB	Ablative materials - mechanical properties
449	WPAFB	Ablative materials - thermophysical properties
450	WPAFB	Ablative materials - fabrication
451	WPAFB	Composites use in turbines
452	WPAFB	Destructive & non-destructive testing
453	WPAFB	Catalytic activity of structural surfaces
454	WPAFB	Metal processing lubricants
455	WPAFB	Mathematical analytical techniques
456	WPAFB	Axial loading fatigue properties
457	WPAFB	Radiation effects; optical properties of TiO_2
458	WPAFB	Acoustic loss materials
460	WPAFB	Chemical structure of polymers
461	WPAFB	Mechanical properties of magnesium casting alloys
462	WPAFB	Mechanical properties of compatible magnesium casting alloys

Search No.	Requestor	Topic of Search
463	WPAFB	High strength refractory filaments
464	WPAFB	Hydrogen embrittlement of steel
465	WPAFB	Lubricants for processing of refractory Metals
466	WPAFB	Glass lubricants for metal working
467	Univ. of Dayton	Compatibility of NAK
468	WPAFB	Thermal control coatings
469	WPAFB	Surface finishes
470	Univ. of Dayton	Chromium superalloys check
471	Univ. of Dayton	Cobalt superalloys check
472	Univ. of Dayton	Nickel superalloys check
473	Univ. of Dayton	Iron superalloys check
475	WPAFB	Welding of Ti and Al alloys
476	WPAFB	Shear modulus of panels
477	WPAFB	Niobium - Rhenium alloys
479	WPAFB	Filament winding glass fiber fuel hoses
481	Univ. of Dayton	Metal composites
482	WPAFB	Ceramic thin films
483	WPAFB	Manufacturing control of mask alignment
485	WPAFB	Cross linked polymers
487	WPAFB	Coatings - mechanical props.
488	WPAFB	Coatings - physical props.
489	WPAFB	Coatings - evaluation
490	WPAFB	Coatings - uses
491	WPAFB	Coatings - specific materials
492	WPAFB	Coatings - specific types
493	WPAFB	Forming of ceramics
494	WPAFB	Nucleation aggregate size
495	WPAFB	Far infrared spectrometers
496	WPAFB	Nondestructive testing of diffusion coatings
497	Univ. of Dayton	Hot pressing polymer composites
498	WPAFB	Lubricants for metal working
499	WPAFB	Magnesium - lithium alloys
500	WPAFB	Laboratory techniques for thermal shock testing
505	WPAFB	Cadminum - nickel plating
511	Univ. of Dayton	Nondestructive testing of ceramic coatings
512	WPAFB	Coefficient of thermal expansion
516	WPAFB	Microwave windows
517	WPAFB	Plasma casting of beryllium
518	WPAFB	Design & reliability of gas turbine engines

Search No.	Requestor	Topic of Search
519	WPAFB	Composition effect on mechanical properties of composites
520	WPAFB	High temperature adhesives
522	WPAFB	Fatigue cracking of stainless steels
523	Univ. of Dayton	Metal composites
524	WPAFB	Benzyne chemistry
525	WPAFB	Surface free energy of single oxides
526	Hamilton-Standard	Creep of aluminum 2219-T6
527	Hamilton-Standard	Steel AMS 56-25
529	WPAFB	Sandwich construction
532	WPAFB	Cleaning or preparations surface for joining coatings
542	WPAFB	50 - 50 nickel chromium alloys
543	WPAFB	Mechanical properties of metal composites
544	WPAFB	True fracture stress on metals

MANUAL SEARCHES

Search No.	Requestor	Topic of Search
M-47	WPAFB	Strength of riveted aluminum joints
M-48	WPAFB	Fluorescent paints
M-49	WPAFB	Protective coatings for fibers
M-50	WPAFB	Crazing or failure of reinforced plastics
M-51	WPAFB	Thermal conductivity of refractory metals and alloys
M-52	WPAFB	Compatibility of metals
M-53	WPAFB	Reinforced plastics
M-54	N. Amer. Aviation	Cloth finishes for reinforced plastics
M-56	WPAFB	Mechanical properties of thoriated tungsten
M-57	WPAFB	Vibrational damping of reinforced plastics
M-58	WPAFB	Microorganism contamination of fuels
M-59	WPAFB	Excited states, lasers and masers
M-60	WPAFB	Mixing of solid propellants
M-61	WPAFB	Processing of glass filaments
M-62	WPAFB	Slip casting of silicon dioxide (Quartz)
M-63	WPAFB	Compatibility of fluorine below 200°F
M-64	WPAFB	Techniques for forming electrects
M-65	WPAFB	Refractory silicides
M-66	WPAFB	Boron nitride

Search No.	Requestor	Topic of Search
M-67	WPAFB	Thermal properties of PuO_2 and UC/Z
M-68	WPAFB	Ultraviolet degradation of polystyrene films
M-69	WPAFB	Superalloy sheet development
M-70	WPAFB	Properties of Ni - Span C
M-71	WPAFB	Chemical analysis of tungsten silicide
M-72	WPAFB	Rain erosion resistance coatings
M-73	WPAFB	Lubrication in vacuum
M-74	Univ. of Dayton	Magnetic cores
M-75	WPAFB	Electrical insulation for electrical wires
M-76	WPAFB	Phase diagrams of water, hydrazine aniline ternary system
M-77	WPAFB	Moxness compounds MS-70A02
M-78	WPAFB	Cold welding or diffusion bonding of aluminum alloys
M-79	WPAFB	Laminated metal foil
M-80	WPAFB	High temperature properties of methane, ethane and propane
M-81	WPAFB	Critical constants of metals
M-82	WPAFB	Diffusion bonding, beryllium, stainless steels
M-83	Foreign Tech.	Inorganic, non-metallic materials
M-84	WPAFB	Stress relief of welded nozzle shields
M-85	WPAFB	1700-1900°F stress rupture of udimet 700 forging
M-86	WPAFB	Creep and oxidation of Inconel 713C
M-87	McClelland AFB	Transverse tensile of aluminum 7075-T6
M-88	WPAFB	Charpy impact of aluminum 2014-T6 and magnesium ZK-60
M-89	WPAFB	Paper reinforced phenolic composited
M-90	WPAFB	Fracture stress inorganic materials
M-91	WPAFB	Fluidized beds
M-92	WPAFB	Electrical contacts
M-93	WPAFB	Flammability of fuels
M-94	Univ. of Dayton	Failure theory of plastics
M-95	WPAFB	Mechanical properties of waspalloy
M-96	M&T Chemicals	High viscosity fluids-500 CPS at room temperature
M-97	Univ. of Dayton	Adsorption on inorganic solids
M-98	WPAFB	Waspalloy
M-99	WPAFB	Reclamation of ammonium perchlorate
M-100	WPAFB	Surface tension & viscosity of boron
M-101	WPAFB	Machining of steel

Search No.	Requestor	Topic of Search
M-102	WPAFB	Electrochemical machining of Be & Be alloys
M-103	WPAFB	Accommodation coefficient
M-104	WPAFB	Superconductive materials
M-105	WPAFB	Spin wave instabilities
M-106	WPAFB	Ion sensitive inclusions
M-107	WPAFB	Chemical analysis of microsamples of metals
M-108	WPAFB	Polyurethane elastomer coatings
M-109	WPAFB	Rain Erosion
M-110	Aerojet-General Corporation	Tensile properties of glass fibers
M-111	WPAFB	Superalloys in jet engines
M-112	WPAFB	Extrusion stiffening of titanium
M-113	WPAFB	Slip casting of metals
M-114	WPAFB	Mechanical properties of lockalloy
M-115	WPAFB	Coining of powder metals
M-116	WPAFB	Charge transfer complexes
M-117	WPAFB	Thermodynamic properties of carbon dioxide
M-118	WPAFB	Multilayered soap films
M-119	WPAFB	Electronic conduction in polymeric organic systems
M-120	WPAFB	Phase diagram for titanium-silicon-carbon
M-121	WPAFB	Chemical coupling agents
M-122	WPAFB	Survey of AFML documents on various materials
M-123	Borg-Warner	Properties of copper-beryllium
M-124	I.T.E. Circuit Breaker Co.	Siezure in vacuum
M-125	WPAFB	Hydrogen embrittlement of steels
M-126	"Chemical Week" Magazine	Deposition of fluorine atoms
M-127	WPAFB	Aluminum alloys for salt spray corrosion
M-128	WPAFB	Rain erosion of helicopter blades
M-129	Hamilton-Standard	Mechanical properties hiduminum
M-130	WPAFB	Flammibility, ignition of hydrauiic fluids
M-131	WPAFB	Organo-mercury compounds
M-132	WPAFB	Rolling of superalloys
M-133	WPAFB	Dispersion hardening of nickel alloys
M-134	WPAFB	Metallurgical stability of nickel alloys
M-135	WPAFB	Creep of aluminum 2024-T0

Search No.	Requestor	Topic of Search
M-136	WPAFB	Properties of aluminum C-355 and magnesium EZ-33
M-139	Globe Industries	High strength materials for pressure vessels
M-140	WPAFB	Non-destructive testing
M-141	WPAFB	Bibliography on steel A-302 and Steel A-204
M-142	WPAFB	Phosphorus sulfide (P_4S_3) coolants

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) University of Dayton Research Institute	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

Operations of a Document Retrieval System Using a Controlled Vocabulary

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Summary Report, 1 December 1964 - 30 November 1965

5. AUTHOR(S) (Last name, first name, initial)

Janning, Edward A.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
March 1966	20	2

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
AF 33(615)-1132 b. PROJECT NO. 7381 c. Task No. d. 738103	AFML-TR-66-36 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. AVAILABILITY/LIMITATION NOTICES

Distribution of this document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	AFML (MAAM) Wright-Patterson AFB, Ohio

13. ABSTRACT

This report describes the effects that a controlled vocabulary has on the indexing and searching operations of the document retrieval system established by the University of Dayton for the Air Force Materials Laboratory. The system contains about 30,000 scientific and technical reports covering all aspects of materials research and is controlled by a vocabulary of 10,000 terms. In general, the use of a controlled vocabulary has been found to be very beneficial to the overall operation of the system. Also described are three search strategies that are used to effectively retrieve information in a format that is more useful to a user than merely a list of document numbers.

DD FORM 1 JAN 64 1473

Unclassified
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Document Retrieval System Coordinate Indexing Vocabulary Control Search Strategy						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers *(either by the originator or by the sponsor)*, also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS), (S), (C), or (U)*.

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.